POOL Service

"SATISFACTION FOR SASKATCHEWAN"

PROJECT NO. WF9AA1A

PNEUMATIC APPLICATORS - NEW TECHNOLOGY FOR APPLYING FERTILIZER AND SEEDING

A paper presented to the Soils and Crop Workshop, February 18-19, 1980 Saskatoon, Saskatchewan

R. E. Morgan

G. Hultgreen

C. Van Teeling

INTRODUCTION

There has been a great deal of discussion in the past few years about the pros and cons of fertilizer placement, more so with the increased use of anhydrous and aqua ammonia. The deep narrow band placement of this ammonia has been said to be the main reason for the increased crop yield obtained as compared to that when "dry" fertilizer is broadcast and incorporated.

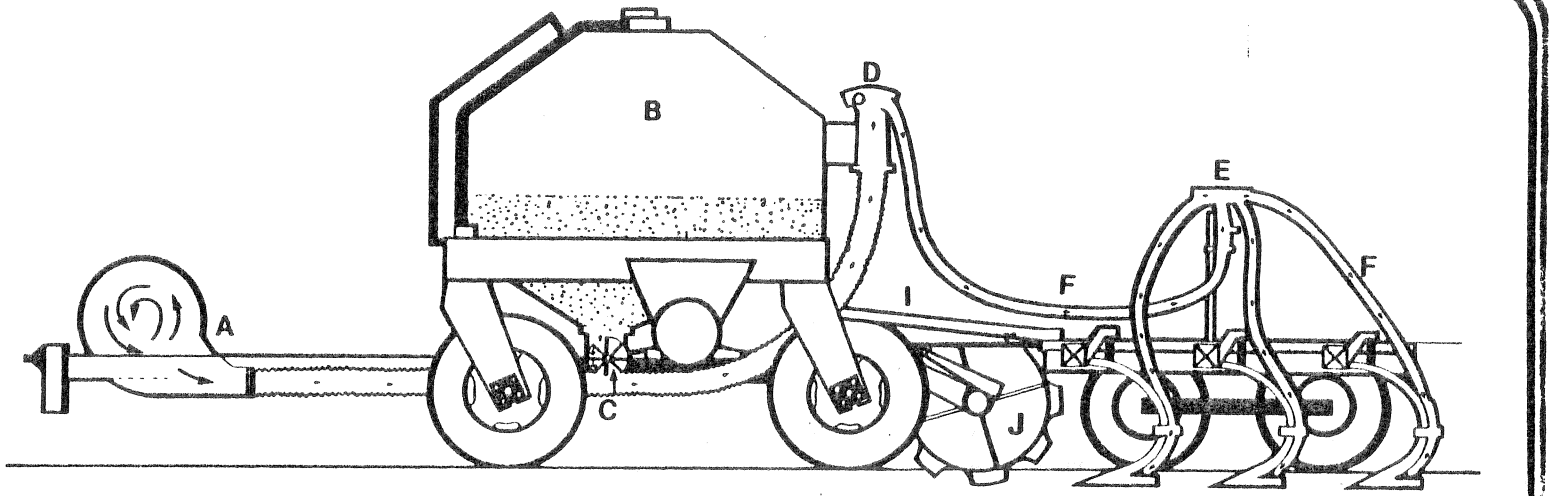
WCFL research has indicated that banding dry fertilizer can increase the yield by 1-5 bushels per acre and that these increases could be doubled if phosphate is banded with the N. The drier the region the greater the potential benefits from deeper placement.

Equipment has not been available for banding of "drys" until recently. The machinery now on the market are referred to as pneumatic applicators, or sometimes as air seeders. They are pull type field implements which will cultivate and deep band fertilize or seed and/or fertilize in one operation. Equipped with a "Beline" type applicator, granular herbicides can also be soil incorporated.

If one refers to Figure I it can be readily seen that a typical unit consists of:

a) a cultivator which can be separate or an intrinsic part of the total unit
b) a seed and/or fertilizer tank(s) capable of handling up to 140 bushels (3.5 tons of urea)
c) a Venturi-type air system which can be driven by a separate motor or with a tractor via the p.t.o. or hydraulic system
d) a metering system which can be roller or fluted wheel units
e) the boots - the end distribution points behind the shank

The aforementioned labor-time benefits of combined field operations along with the possibility of improving the performance of dry fertilizers by improved placement practices to a level of that of anhydrous/aqua ammonia led the Product Development Branch of the Saskatchewan Wheat Pool to the decision of undertaking this study. It involved four machines. Three of them are commercially available and with pneumatic feed; the Prasco Super Seeder 75-57, the Friggstad and the Wil-Rich. A fourth machine was the gravity flow West-Ag Band-It.



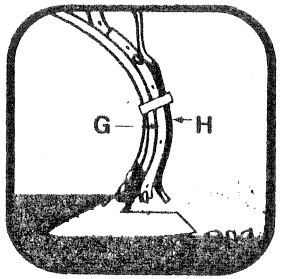
A. Blower — Driven by a hydraulic motor to be run from tractor hydraulic system or a separate hydraulic system.

B. Grain Tank — Hopper bottom. One fill hole. Clean-out door.

C. Metering Device — Meters all types of grain accurately into the air stream.

D. Primary Manifold — Distributes grain accurately to secondary manifolds.

E. Secondary Manifold — Distributes grain accurately to each shank.



F. Flexible Tubing — Carries grain. This allows wings to be folded with no alterations to seeding system.

G. Boot — Plastic boot is located behind shank to protect it from rocks.

H. Liquid Fertilizer Holder — Holds liquid fertilizer tubes in place behind seed tube.

I. Rolling Hitch — Allows chisel plow to follow contour of ground for accurate depth control.

J. Ground Drive Wheel — Drives seed metering device and liquid fertilizer pump with no clutches. Wheel is lifted off ground when chisel plow is raised.

FIGURE I typical pneumatic applicator - schematic courtesy of Prasco

The following objectives were set.

1) To determine if the pneumatic seeding concept will provide equivalent results to that of present seeding equipment.
2) To obtain data on the new applicators when used for spring and fall application of fertilizer. Of special interest will be the effect, if any on yields.
3) Concomitant the above differences will be examined in terms of yield and season end nutrient status when the fertilizer is broadcast, banded or double shot.
4) To investigate the possibilities of integrating the new machinery into a total production concept including the application of herbicides, etc.
5) To demonstrate pneumatic fertilizer and seeding systems on a farm basis and to evaluate the agronomic practices in regards to their use.
6) To assess a number of machines commercially available in Saskatchewan under Saskatchewan conditions.

Besides the on going close cooperation of the equipment manufacturers the Prairie Agricultural Machinery Institute (PAMI) provided a valuable input and intends to carry out its own evaluations this crop year.

Methodology

Before moving into a discussion of the methodology a brief description of the machines is warranted.

a) Prasco Super Seeder 75-57

This unit is designed to be adapted to most makes of heavy duty or field cultivators. The machine consists of two pressurized tanks mounted on four large castor wheels. The tank assembly replaces the hitch on the cultivator. A hydraulically powered fan provides the air stream which carries the fertilizer/seed through a series of manifolds to each shank. Fluted wheel metering devices (one for each tank) meter the product into the air stream for delivery into the shanks. The meters are driven by a chain from a ground drive wheel.

b) Friggstad

This is a pneumatic applicator designed as an integral part of the Friggstad heavy duty cultivator. The machine has one large tank divided into two compartments, each with its own metering system. The fan, powered by a gasoline engine, provides the air stream which carries the product through a series of manifolds to each shank. Fluted wheel metering devices dispense the product from each tank into a common air stream for delivery to the shanks. The meters are driven by a hydraulic motor system powered by a ground drive wheel. The weight of the tank is supported by the cultivator hitch in front and by dual castor wheels at the back.

c) Wil-Rich

This pneumatic unit is designed to fit on the Wil-Rich vibra shank field cultivator. It consists of two tanks each divided into one compartment for seed and one for fertilizer. Removing a divider converts the tank for use with one material only. The tanks are mounted directly on the hitch of the machine. Rubber rollers driven through a series of chains meter the fertilizer/seed into the individual seed cups (one cup for each shank). High volume air from the p.t.o. driven fan is directed into the seed cup where it picks up the material and delivers it through a plastic tube to each shank. Changes in feed rates are made by changing sprockets on the final drive.

d) Western-Ag - Bandit

This prototype is a 29 foot cultivator type machine only designed to apply dry granular fertilizer. It is gravity fed using three large tanks mounted the length of the cultivator. Rubber rollers at the bottom of the tank meter the fertilizer into plastic tubes which direct the granules below and behind the shanks. The rubber rollers which control the feed rate are ground driven through chains by a variable displacement hydraulic pump and motor system. The cultivator unlike the others above is not a wing type machine. The frame is supported by a number of wheels positioned outside of the machines

d) Continued

frame. These wheels are swivelled 90 degrees from working position and the unit is pulled from one end for transport.

The project was divided into two parts a. intensive onsite (Watrous) testing
b. offsite farmer co-operator testing

a. The onsite study was further divided into two sections. One involved the direct comparison of the four machines. The second centered on one unit for a more exhaustive examination of the new application concept. All units were equipped with standard shovels.
   1. Friggstad and Prasco - 16" sweeps
   2. Wil-Rich - 9" sweeps
   3. West-Ag - 2" spikes

   Due to the size of the equipment the field work was unreplicated. It was carried out on wheat stubble which will be seeded to Neepawa wheat in the spring. The strips were 185 x 12.5 metres. Most of the work outlined in Table 1A employed a double pass technique (Figure II) so that direct comparison can be made of air seeding vs. conventional double disc press drill seeding in the spring. Tests in Table B are composed of about 80% of double and 20% single pass plots. Only urea at 60 lbs. and phosphate (11-51-0) at a suitable rate were used. Any additional fertilization required to reach soil test recommendation will be carried out in the spring. Soil moisture and temperature readings were taken during application and will be taken again at appropriate times in the spring.

FIELD PLOT SETUP

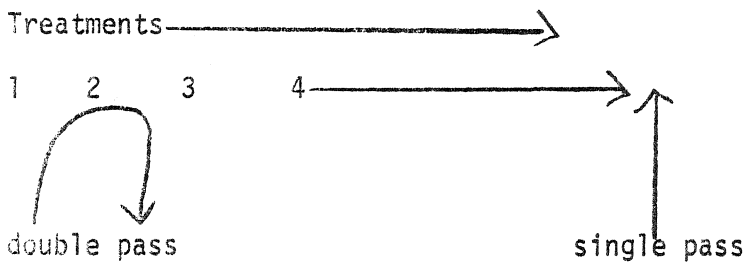


Figure II

TABLE I OUTLINE OF TREATMENTS ON WATROUS FARM

A

Treatment	Fall	Spring
1.	urea air	air seed and phosphate
2.	urea air	conventional seed and phosphate
3.	urea air	air seed and phosphate
4.	urea air	conventional seed and phosphate
5.	urea air	air seed and phosphate
6.	urea air	conventional seed and phosphate
7.	urea air	air seed and phosphate
8.	urea air	conventional seed and phosphate
9.	urea gf	conventional seed and phosphate
10.	2 x urea gf	conventional seed and phosphate
11.	urea conventional	conventional seed and phosphate
12.	no fertilizer	conventional seed and phosphate

NOTE - 9 and 10 - West-Ag

B

Fall		Spring
1.	urea air	air seed and phosphate
2.	urea air and phosphate	air seed
3.	urea air and phosphate	air seed and little phosphate
4.	urea air and phosphate	conventional seed
5.	nothing	air seed with total fertilizer
6.	urea air and phosphate (band)	conventional seed
7.	urea air and phosphate	conventional seed and little phosphate
8.	urea air broadcast & cultivate	conventional seed and phosphate
9.	urea air broadcast	conventional seed and phosphate
10.	Aqua ammonia	air seed and phosphate
11.	aqua ammonia	conventional seed and phosphate
12.	urea and phosphate air broadcast and cultivate	conventional seed
13.	urea broadcast on snow	conventional seed
14.	nothing	fertilizer banded and conventional seed

d) a. Continued

To ensure that unnecessary variability was minimized among treatments all were cultivated to the same extent such that if a plot was air fertilized the cultivation was included in the single treatment while if broadcast the cultivation was then carried out with the same machine after the treatment.

Both written and photographic records on the performance of each machine during the fall program were maintained. This will be continued in the spring.

The spring program will be geared to the seeding aspect of the new technology. Seeding depth and placement will be closely monitored. Weed control will be by standard agronomic practice. Yields will be both via subplot and overall plot procedure. Thus statisitical analysis will be possible if necessary.

b. The Farm Service Centre managers in Raymore and Regina along with an advertisement in the Watrous paper helped solicit farmer co-operators for the offstation program which was going to be centered in these areas. The logistics of moving these machines limited the offstation program to this small size.

A farmer co-operator had to commit himself to the following:

1) soil test for fall recommendations
2) fertilize to this recommendation a minimum of 80 acres in the fall
3) have a tractor of about 150 h.p. compatable with the assigned unit
4) be willing to seed in the spring using the recommended spring fertilizer rates
5) be willing to have signs out and participate in tours
6) be willing to use a double rate of urea supplied by Saskatchewan Wheat Pool and have us test harvest

7) be located in the general test area
8) keep operational records in the supplied field book
9) leave a check strip in the field during fall fertilization

The co-operators were told to use the machines as equipped, and to not change the metering setting from the 60 lbs./acre N. This was to prevent time wastage in the field operation. Necessary fertilizer makeup will be carried out at seeding.

Dry soil conditions and the desire of the farmers to prevent unnecessary stubble disturbance prompted the change to smaller shovels on the Friggstad and Prasco such that the former was equipped with 8" sweeps with the deflectors removed and the latter with 4" beavertails.

Signs will be put in place in the spring on the fields demonstrating the technology. A small chosen core of farmers will also seed with the units they used for fertilization. We hope that we will be able to collect some data on these farms comparable to that collected on the Watrous farm.

FALL RESULTS

The fall program saw the elimination of the Western-Ag machine from the project due to engineering problems.

We initially had some concern about the use of the light duty vibrashank cultivator of the Wil-Rich as compared to the heavy duty cultivators of the three other units, but this machine provided good soil penetration even under difficult soil conditions.

Is fertilizer bandwidth and spacing crucial to increased yields over broadcast fertilizer or yields that are comparable to those produced by anhydrous/aqua ammonia? Since we employed a number of bandwidths and spacings with the various machines at Watrous we may see some influence on final yield.

The Prasco and Friggstad were originally designed as seeders and their boot design is optimized for deflection which is needed on the 12" shank setting of their heavy duty cultivators. The 16" shovels that they were equipped with thus produced a 16" band as compared to the 9" band on a 7" spacing produced by the Wil-Rich and the 3-4" band on 7" spacing produced by the West-Ag. All fertilizer was put down at an approximate depth of 4".

Over 5 [illegible] was covered by these machines in the off station program. In general, farmer response was favourable, their cooperation particularly during some trying times was greatly appreciated. The manufacturers were also very helpful therefore providing their technical expertise.

All machines had advantages and disadvantages in our judgment. These will be dealt with when we meet with each of the manufacturers individually later this winter.

Partial funding of this project was made through the WCFL Agronomy Committee.